Low Cost Solution to Retain More Larval Fish: Effectiveness of Using a Fine Mesh Screening on the Holding Tanks

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Summary

The Central Valley Project's Tracy Fish Collection Facility (TFCF), located upstream of the Jones Pumping Plant (JPP) in the southern portion of the Sacramento-San Joaquin Delta (Delta), is responsible for collecting fish (salvage) and transporting them downstream away from the influence of the pumps. Fish that enter the TFCF have to go through a series of louvers and bypasses before being concentrated into a holding tank. The stainless steel holding tank screen (3.76-mm mean hole diameter) retains the fish in the tanks during collection (Sutphin *et al.* 2007). However, small fish like delta smelt (*Hypomesus transpacificus*) can pass through a screen of this mesh size, and this was demonstrated by Sutphin *et al.* (2007) and Wu (2008, personal communication).

The current holding tank mesh size was selected in the early 1950s as it was the smallest screen size shown to operate successfully most of the year and not clog with peat fibers (USBR 1956). This still holds true today, and the holding tank screen only clogs a few days per year.

The early designers did not consider changing the mesh size on the holding tanks to meet the conditions of the debris load in the water, as this was too expensive and labor intensive. With the invention of light weight, flexible, nitex screen it is now possible to change the mesh size of the holding tanks quickly and inexpensively. In 2000 and 2008, short-term pilot studies were completed that looked at the possibility of wrapping a fine mesh, flexible screen around the existing holding tanks screen in spring when debris loads are at their lowest levels and when larval fish are present . In 2000 and 2008,

1000- and 500-µm mesh screens were used respectively. Both net sizes were able to fish for 24 h without clogging. The goal of this study is to determine if the nitex screen is durable enough to be incorporated into the normal salvage operations at the TFCF and if this material will result in a greater number of living larval and juvenile fish being loaded into the fish-haul truck for release back to the Delta.

Problem Statement

Larval fish are lost through the holding tank screen during fish salvage collections. A temporary blanket of 500-µm nitex screen over the existing holding tank screen has shown promise for short-term use.

Goals and Hypotheses

Goals:

1. Determine if the density of swimming larvae in the haul-out bucket is significantly different between the holding tanks with and without the nitex screen.

2. Determine how long a 500-µm nitex screen can be used in a holding tank before it fails (*i.e.*, rips, clogs, rolls down).

Hypotheses:

1. The holding tank with nitex screen will positively affect the density of swimming larvae.
2. The properly installed and durable nitex screen can be left in a holding tank for a long period before it fails.

Materials and Methods

Two 500-µm nitex screens will be used for the entire study. The screens were purchased in 2007/2008 for $700/each, and they completely wrap around the 2.4-m-diameter holding tank screen, up to a depth of 2.4 m. Each screen is installed by wrapping it around the holding tank screen and overlapping the ends of the nitex screen so that waterflow keeps the screen impinged against the holding tank screen. Three ropes encircle the screen and are attached with bungee cords. They go along the top, middle, and bottom of the screen. A ladder is needed to secure the rope along the top of the screen. During the pilot study, the installation or removal of the screen required less than 10 min of work once the tank was empty and locked out. In addition to the nitex screen around the holding tank, nitex screen is also installed on the haul-out bucket which has 2.5-mm perforated holes.

At the conclusion of each sample period, both holding tanks will be drained simultaneously by an operator in preparation for removing the fish to the haul-out truck. The sampler will document the type (peat, woody, Egeria) and approximate amount of debris (low, average, or heavy) in the sample. The tank that is sampled first each day will alternate. The sampler will take a fish density sample from the 1703-L haul-out bucket once it is lifted up to waist level. Three 18.9-L black buckets will be used to take a subsample of the swimming larvae/juveniles in the haul-out bucket. This will be

completed by quickly submerging the entire bucket and removing it quickly. Dead larvae inside the haul-out bucket should sink to the bottom and should not contaminate the sample.

After the paired sampling period, the nitex net can be used for longer duration testing. The purpose of this testing is to see if the material can withstand continual use. The nitex screen will be installed on holding tank 3 or 4 and operated and cleaned under normal operating conditions. The waterflow through the screen, tank depth, debris types entering the tanks (peat, wood, or Egeria), and screen differential will be monitored daily until screen failure (clogged or ripped). A clogged screen will be defined as a clearly visible differential (~100 mm) over the face of the screen. Once the screen is clogged is must be cleaned off with the high pressure utility hose and then put back into operation. The rate of clogging will be documented to see if clogging is more frequent with a seasoned screen than a new screen. Once a screen has been in place for 2 weeks, it will be washed down and bleached (5% sodium hypochlorite for 10 min) and air dried to kill the biofouling microorganisms. The cleaning of the nitex screen is best done in place, but can also be completed once it is removed. If it is cleaned in place, the chorine will be neutralized with sodium thiosulfate before releasing it back to the Delta. The purpose of continually using the nitex screen is to see how long it lasts when used in production mode and if the cleaning process restores it back to the original condition. As water temperature in the Delta warms up, we are expecting the rate of biofouling to increase.

Data Analysis and Interpretation

Statistical tests for paired sampling procedures will be used to evaluate the samples. The number of swimming fish from the haul-out buckets will be used to assess the effectiveness of two treatments (nitex screen vs. no screen). If fish are being collected more efficiently by the nitex net, but consequently killed while being held in the holding tank, they should sink to the bottom of the haul-out bucket and not interfere with the measurement.

For this sampling program it is assumed that the flow rates passing through the two tanks are nearly equivalent. If the total measured flow between the two tanks is off by more than 20% for any paired sample, that sample must be discarded. This experiment is trying to show that there are huge differences in collection efficiency (>50%) between the treatments and small inequity in holding tank flows should not interfere with the results.

Paired holding tanks samples will be used to determine if there is an association between holding tank screen size and the number of delta smelt collected. In addition, the association between screen size and size class of smelt (11–15, 16–20, 21–25 mm TL) collected will be investigated. A chi-squared goodness of fit test will be used to make these comparisons. If a significant difference is detected, the percent change from the normal condition (no nitex screen) will be calculated.

Paired samples were collected from April 1 to June 10, 2009. Samples collected will be processed and data analyzed in 2010. Rate of nitex screen clogging will also be tested in 2010.

Coordination and Collaboration

The study will be coordinated with the TFCF biology staff, TFCF Fish Diversion Crew (Joel Imai), and TFCF management (Ron Silva). René Reyes is the PI for this project and will direct activities. René will coordinate with the onsite operators, write a job hazard analysis, and obtain permits for this work. Brent Bridges and Brandon Wu will assist René with screen installation, cleaning, and purchasing. This project cannot be completed unless the operators are willing to help collect the samples and fix/remove the net in the event that it fails. In addition, this project cannot be completed unless the flow meters are working for both tanks 3 and 4.

Endangered Species Concerns

Delta smelt are currently being petitioned to be placed on the endangered species list. The sampling program for this project is scheduled to coincide with the larval/juvenile delta smelt season and therefore we will potentially take many of these fish. The intention of this project is to find a way to improve the salvage operations for delta smelt larvae/juveniles so that more of them are released back to the Delta. In addition, during our sampling we are likely to take winter run salmon (*Oncorhynchus tshawytscha*). California Department of Fish and Game (CDFG), and National Marine Fisheries Service will be given a copy of our proposal for consideration. The biological opinion written by the U.S. Fish and Wildlife Service already grants us permission for completing this type of study to help increase the salvage operations. Any ESA listed species collected from the 18.9-L bucket samples will be measured and counted. Adult delta smelt or juvenile salmon collected in this sample will be returned back to the Delta. All larval/juvenile delta smelt in the 18.9-L sample will be preserved. Take for this project will be reported daily to CDFG and take will consist of fish collected in our 18.9-L sample and not in the entire holding tank. We anticipate that with ten paired samples it would be possible to capture up to 10,000 larval/juvenile delta smelt.

Dissemination of Results (Deliverables and Outcomes)

The primary deliverable will be an article published in the Tracy Volume Series. Technical updates will be provided at TTAT meetings.

Literature Cited

Sutphin, Z., B. Bridges, B. Baskerville-Bridges, and R.C. Reyes. 2007. *Evaluation of current and historical 10-minute count screens at the Tracy Fish Collection Facility, Tracy, California*. Tracy Fish Collection Facility Studies, Volume 31. U.S. Bureau of Reclamation, Mid-Pacific Region and Denver Technical Service Center.

USBR (United States Bureau of Reclamation). 1956. *Designers' Operating Criteria for Fish Collecting Facilities: Delta-Mendota Intake Canal*. Engineering and Research Center, Denver, Colorado.

Wu, B. 2008. *Evaluation of the Tracy Fish Collection Facility holding tank screen entrainment efficiency for juvenile delta smelt (Hypomesus transpacificus)*, personal communication.